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ABSTRACT

The method of utilizing a criterion-referenced testing system by employing the following progression of curriculum development is recommended: 1) A theory of childhood development or learning is identified; 2) Curriculum is developed based upon that theory; 3) Criterion-referenced tests, with items stated in behavioral terms, are developed. An appendix discusses a study of pre-reasoning abilities in preschool classes and includes a comparison of results of three curricular approaches. (MS)

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FROM THEORY TO CURRICULUM; THEN (AND ONLY THEN) - EVALUATION

By

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An address given as part of a Symposium on Testing
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TM 000 809

(Preface: Mr. Fred Garbee, California State Consultant, has reported that the top educational priorities of the State Superintendent of Public Instruction are (1) accountability, (2) school finance, (3) early childhood education, (4) drug abuse, (5) state department reorganization, and (6) education code revision. This presentation will center upon the first and third of these priorities.)

I. Introduction

In the preceding presentation, Dr. Castenada has been discussing standardized testing as a device which:

a. does not yield accurate and useful information when applied to the various cultural subgroups, and which

b. tends to dictate curriculum.

In addition, there is a discussion of modes of learning and modes of relations as seen in incentive-motivational systems.

It is quite interesting that a paper designed to center upon the ills of mandated testing seems to spend much of its time in the discussion of learning, curriculum, and teaching--but shouldn't that be the genesis of criticisms of testing? Isn't the problem one of replacing mandated tests with an evaluative system which reflects what is going on in the classroom, and then realizing that what is being reflected has its own gross problems? In this sense, then, utilization of a properly designed testing program will do what a mandated system has never even claimed to do--expose classroom problems, process, materials, relations, and teaching. (The handling of this exposure, alone, and the attendent ethical problems, could create a whole new consultant area for the State Department of Public Instruction.)

The argument to be advanced in this paper is that the single best method of utilizing a criterion-referenced testing system would be to follow a progression of curriculum development, such that:

a. A theory (or model) of childhood development or learning is identified.

b. Curriculum is developed based upon that theory or model.

c. Criterion-referenced tests, with each item stated in behavioral terms, will be developed.

The following sections will be presented in such form as to give greater understanding of what it means to tie both curriculum and testing to a theory or model. The second section

presents a brief background in terms of identifying a language model for young children (it would be best to have a theory to lean upon, but a simpler model is used, instead). Having identified the model, both curriculum and assessment ideas will be presented.

The third section is intended to give a rather thorough set of comments about Piaget's theory of childhood thinking, centering upon two operations (or broadly generalizable skills) which the theory designates as being important in developing early reasoning ability at the 4-5-6-7 year age level. This section will also progress onward (having identified a theory, in this case) into curriculum development and assessment.

Finally, a short set of conclusions and related points draws together three of the major arguments and clarifies a few of the more troublesome points relating to criterion-referenced testing.

II. A Model for Language

It seems appropriate when writing in the area of early education and language to begin with a story.

One day six blind men were sitting beside the road chatting when a small boy announced that a man was coming toward them leading an elephant to the king. They begged the child to stop the man and elephant so that they may know what an elephant was.

Each went forward and took hold of some part of the elephant and exclaimed his finding.

The First thought it was like a wall.

The Second said no, it was round and hard.

The Third denounced the other two and proclaimed it to be round and soft.

The Fourth shock his head in dismay knowing that it was really like a tree.

The Fifth laughed wildly at their assertions as he had the true answer to what an elephant was like after all it felt like a giant fan.

And the Sixth kept secretly to himself the knowledge that in fact to his senses it was a very coarse rope.

> The man with the elephant moved on and the six blind men returned to the side of the road talking excitedly to one another. They talked and talked on and on into the night without ever coming any closer to agreement on the total animal.

Language: A Brief Model. We are faced with many elephants in early education today. The one proposed for this section is called simply "language" or "language development." It is our contention that a brief outline of the "whole" of the subject will prevent fragmentation in the discussion of evaluation of language for early ages.

Language is more than just vocabulary building, more than just speaking when spoken to, more than just having something to say, and more than just pronouncing words correctly. Contrary to some popular beliefs, language is a non-arbitrary system of rules devised for the purpose of speaker-listener communication.

The system of language can be divided into three major components:

1. Phonology--sounds, articulation
   Example: 'dog' (d+o+g)
2. Syntax--grammar
   Example: 'I see the dog' (I+see+the+dog)
3. Semantics--meaning
   Example: 'He is a dog.' (Interpretation in the mind of the speaker and listener.)

These categories constitute the language model used in establishing that curriculum which is to be later evaluated by meeting the stated established criterion.

Language also has its functional/behavioral aspects which may be grouped again under three headings. However systematic the initial three components were, these latter three classifications are a bit arbitrary and may overlap in the reality of the classroom. Language, in terms of the loose, functional-behavioral aspects, is used to:

1. Impart information.
   Example: "The sky is blue."
2. Establish social contact
   Example: "Hi, whatcha doin"?
3. Impart emotion.
   Example: "I hate it"!

However, teaching the use of language takes place in a social-learning atmosphere, and tends to be more difficult to present and evaluate within the constraints of criterion testing. Evaluating the components of language (the first model) is easier in that it is only a matter of establishing sequential tasks appropriate to both the child's approximate age group and the specific component in question.

Current Preschool Language Programs. Few preschool programs provide specific curriculum which covers all three components of language. The Peabody Language Development Kits cover primarily meaning as related to vocabulary development and reasoning skills, while the Bereiter - Engelmann Language Program focuses on syntactic and phonological skills in language development. Meaning is also presented in the latter case, but it may be deeply imbedded within the rote of sentence repetition and not too functional in a practical application situation (see comparative study in Appendix I). Traditional preschool programs foster the use of language best, but are weak in the organized, sequential development of the components of language.

Population--Childrens' Language Skills. Linguistic needs vary from population to population, and no one program may serve all. Consider the varying ethnic composition of the populations to be trained and evaluated.

The children with bi-lingual skills benefit from the vast knowledge accumulated through ESL Projects (English as a Second Language). However, many Black children are not generally regarded as coming to school with a second dialect, but rather with "bad English." Their needs are quite similar to those of the bi-lingual Mexican- and Filipino-Americans, except that the Black operates with a regional dialect effective throughout the community from which he comes. However, this dialect is probably not adequate for the school, or for many of the teachers in the early projects. A program of "School English as a Second Dialect" needs to be established with the same rigors as the ESL programs for the bi-lingual children.

Evaluative Measures. Scattered measures are available but no one measure is available to cover the three components of language (as stated in the first model presented). In the area of phonology, Speech Therapists serve as the best resource in using their own skills and knowledge of what is available commercially. The second component, syntax, is receiving attention by Linguists and Speech Pathologists alike. It has filtered to the educational system as the "New English" for elementary and secondary schools, but has had little practical effect on the area of early childhood education. Experimental tests are being devised and research journals may be the best source of information. The third component, meaning, leads to the discussion of the relationship of the symbol to the object and evolves to the question of the impact of language on thinking (to be explored in the next chapter). In this section, it is sufficient to note that those words which tend to link childhood language and thinking are those which are called prepositions, comparatives, and superlatives. As a group, they may be identified as relational words.

Summary and Recommendations. Since language is both systematic (components of language) and behaviorally arbitrary (uses of language), it poses a challenge to individuals responsible for directing and/or evaluating a language development program for young children.

There is a need for persons with an academic background to be used in teaching from theoretical models; persons who not only know the subject matter but are able to: (1) relate the knowledge to the developmental age differences, (2) organize the knowledge into sequential steps within any one given age group, and (3) who possess the human quality of being objective enough to present the whole of the animal, instead of concentrating on one skill within the total theory or model.

The success of locally devised goals, materials, procedures, and evaluation rests ultimately upon the skills and competence of the local personnel. This, then, is the alternative to state mandated testing in the area of language and language development for early education.

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III. Childhood Thinking (or Reasoning)

In the area of early education, much attention has been given to intentional training of the child's linguistic skills. This is most proper as language dominates man's communicative abilities. Since teachers often call upon the child to speak in order to assess that child's reasoning capabilities, equal attention should be given at the early school level to assessing the child's reasoning abilities.

Jean Piaget has theorized that early reasoning is developed as the child works with (1) classifying, or grouping and (2) seriating, or ordering. Classifying can be thought of as the word training which the teacher does as she tries to help children develop concepts, such as tree, blue, or fuzzy (these are usually nouns or adjectives). Seriation is exemplified in a more relational set of words, each of which is helpful in ordering a collection of things. All of the comparatives (near) and superlatives (taller than) are relational, and, by definition, all of the prepositions (under) are also ordering types of words.

(The source reference to this theory is Inhelder and Piaget's The Early Growth of Logic in the Child; New York: Harper and Row, Publishers, 1964. A model of this portion of Piaget's theory has been appended as the last page in this paper.)

Curriculum. This theory has now specified that ordering and grouping are important components of the readiness program because they are the basic building blocks of reasoning. Therefore, the local school district should charge its curriculum committee with filling in the following diagram in terms of reasoning instruction:

Cognitive Areas: Curriculum Development Guide

		Seriation	Classification
Ages	4	Cell #1	Cell #5
	5	#2	#6
	6	#3	#7
	7	#4	#8

That committee might make the following choices (ones that are far too brief in reality to take care of the totality of curricular needs):

a. In cells #1 and #5 the committee might make conscious choice to not provide any curricular materials until widespread preschool classes were instituted. Existing day-care centers would use curriculum based upon reasoning-type games, as suggested by Sharp.[13]

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[13] Evelyn Sharp, Thinking is Child's Play, (New York: Avon Books, 1970).

b. Age 5 or kindergarten children would be given a carefully sequenced approach to both ordering and grouping (Cells #2 and #6) through the use of the Learning Readiness System Kit.[14]

c. At the first grade or age 6 level (Cells #3 and #7) children will be assessed in both ordering and classifying skills. Those who need additional work will again use portions of the Learning Readiness System Kit,[15] since the curricular items allow a great deal of free response. Those who do well in the two skills can move on to the enrichment lessons in the LRS Kit, and may also use some of the play activities of Early Childhood Curriculum.[16]

d. The older children of age 7 (Cells #4 and #8) will be reassessed, with the less competent children being placed in curriculum designated as easy in the AREA materials.[17] Those who are more competent will move into the harder AREA materials and into the second section (more difficult games) as outlined in Sharp's book.[18]

Criterion-Referenced Tests. Once the decision has been made to consciously teach reasoning at all four age levels, then and only then may a decision on testing be reached, for the test will mirror the curriculum.

From this point on assessment will be demonstrated for Cell #1 only. This will cover the area of ordering ability in the four-year-old, near the end of a preschool year (the same assessment is appropriate for Cell #2 when applied near the beginning of the kindergarten experience). As an aid to the reader, all of this assessment has been developed through a series of question-answer interchanges.

Question: Let's look only at ordering. How many ways do we visually order things?

Answer: About two.
(1) Naturally, or by size (small, medium, large)
(2) Pattern, or by copying (——→ ←——)

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[14] Ralph Scott, Ned Ratekin, and Kay Kramer, The Learning Readiness System: Classification and Seriation, (New York: Harper & Row, 1968).

[15] Ibid.

[16] Celia Lavatelli, Early Childhood Curriculum - A Piaget Program, (Boston: American Science and Engineering Co., 1969).

[17] Jerald Nelson and Margaret Drennan, The Assessment of Reasoning at Early Ages (AREA), (In preparation).

[18] Sharp, op. cit.

Question: Okay, so Piaget says that this is important. If so, shouldn't it be related to academic achievement?

Answer: Yes, it should. For example, the correlation between an ordering test and the Metropolitan Readiness Test was 0.82; the ordering test versus the Stanford Achievement Test (Reading and Arithmetic) given two years later was 0.60.[19]

Aha, now we have support for Piaget's theory--a research-based reason why it is important to create a behavioral objective titled ABILITY TO ORDER. Now let's do it.

Question: Just a minute, you unorganized boob. How many behavioral objectives are really needed?

Answer: Well, ah, although we could break it down a little finer, I guess four would do:

	3 or fewer objects	4 or more objects
Natural	1	2
Pattern	3	4

Objective #1 (Natural ordering; 3 objects)

ACTIONS: Observable ordering of three objects which vary in size.

CONDITIONS: The student will be able to order three blocks on three trials, and each time will correctly use the labels small, medium, and large.

CRITERION: Students will be able to carry out completely this ordering task with no errors in three consecutive trials.

Objective #2 (Natural ordering; 4 objects)

ACTIONS: Observable ordering of four objects which vary in size.

CONDITIONS: The student will be able to order four blocks on three trials, and each time will correctly use the labels small and large.

CRITERION: Students will be able to carry out completely this ordering task with no errors in three consecutive trials.

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[19]Jerald Nelson, Construct Validation of the LRS - Seriation Test, (Bloomington, Indiana: Dissertation, 1968).

Objective #3 (Pattern ordering; 3 objects)

ACTIONS: Observable ordering of three objects which vary only in terms of the direction in which they face (⟵ ⟵ ⟶) for example).

CONDITIONS: The student will be able to copy a patterned sequence of three profiles of identical dog pictures, two of which face to the left and one to the right.

CRITERION: Students will be able to carry out completely this ordering task with no errors in three consecutive trials.

Objective #4 (Pattern ordering; 4 objects)

ACTIONS: Observable ordering of four objects which vary only in terms of the direction in which they face.

CONDITIONS: The student will be able to copy a patterned sequence of four profiles of identical dog pictures, two of which face to the left and two to the right.

CRITERION: Students will be able to carry out completely this ordering task with no errors in three consecutive trials.

Comments on Section III. That's it. An attempt has been made to draw the reader from theory through curriculum development and on into criterion-referenced tests. The curriculum was admittedly sketchy, and test items were provided to assess only one aspect of reasoning at one age level, but this only underscores the magnitude of the task of proper testing.

Much remains to be done in terms of identifying theoretically- or model-based curriculum before testing can rationally progress. What is the curriculum for the early school years? What contribution will early school curriculum make in terms of later academic achievement? You may accept the for-going as only a partial answer to these questions, but criterion-referenced testing will at least draw out more and more of the questions which educators should have always asked.

IV. Conclusions

1. Theory (or models) can serve as a guide to determine that which is important to be taught.

2. Theory (or models) insure that an area (such as linguistics) is thoroughly covered.

c. The reflection of the effective use of theory or models shows up in properly-designed, criterion-referenced testing.

Related Points. To prevent the formation of erroneous ideas, it should be noted that:

a. The authors have not proposed that either linguistics or reasoning should be taught in early education. Both are appropriate

b. The criterion-referenced testing program will not be appropriate for research purposes, since many students will be scoring very high on the tests. (See Appendix I for an example of research in which non-reasoning oriented programs were researched through the use of a reasoning-oriented test.)[20]

c. The criterion-referenced testing program is intended for local diagnostic use; it may be supplemented by a standardized testing program (on a sampling basis) if district or building achievement is of interest.

Note About the Authors. Dr. Nelson and Mrs. Drennan are actively engaged in the field of early childhood education. They may be contacted about any of the following projects which have been completed or are now in process (coded N = Nelson, D = Drennan):

a. Sets of felt puppets for instructional use; now are available (D).

b. Educational Puppetry, a book on the educational use of puppets; in progress (N, D).

c. LRS - Seriation Test, an assessment device for ages 3-7, keyed to Piaget's theory; now available through Harper & Row, Publishers (N).

d. The LRS: Classification and Seriation Kit, a structured Kg-1 program keyed to Piaget's theory, uses the overhead projector; now available through Harper & Row, Publishers (N).

e. A review of six research projects keyed to the use of the Seriation Test and the LRS Kit; available next fall (N).

f. The Assessment of Reasoning at Early Ages (AREA), a text and set of curricular items designed to be used in many ways--curriculum study, college text, diagnostic device, inservice text; available soon (N, D).

g. Theory and Reasoning-Assessment: Graded Examples for Teaching, a set of materials for inservice training in seriation--instructor's manual, teacher booklets, slides, and several audio tapes; available soon (N, D).

h. Games and instructional activities for use by parents and teachers; to develop reasoning, linguistic, and other skills in early childhood; catalog available soon (N, D).

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[20]Ralph Scott, Jerald Nelson, and Mary Ann Dunbar, The Learning Readiness System: Seriation Test, (New York: Harper & Row, Publishers, 1968).

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APPENDIX I

A STUDY OF PRE-REASONING ABILITIES IN THE STOCKTON UNIFIED SCHOOL DISTRICT PRESCHOOL CLASSES INCLUDING COMPARISON OF RESULTS OF THREE CURRICULAR APPROACHES

BEREITER - ENGELMANN
PEABODY LANGUAGE DEVELOPMENT
TRADITIONAL

by

Dr. Jerald Nelson
Mrs. Margaret Drennan

May 1969

A STUDY OF PRE-REASONING ABILITY IN THE SUSD PRESCHOOL PROGRAMS

INTRODUCTION:

In the area of early childhood education, much attention has been given to intentional training of the child's linguistic skills. This is most proper as language dominates man's communicative abilities. Since elementary and secondary teachers often call upon the child to speak in order to assess that child's thought patterns and capabilities, equal attention should be given at the pre-school level to assessing the child's pre-reasoning abilities.

Jean Piaget, a leading developmental psychologist, has theorized that pre-reasoning is developed as the child works with classifying (grouping) and seriating (ordering). Classifying can be thought of as the usual type of word training which the teacher does as she tries to help children develop concepts, such as tree, blue, or fuzzy. Seriation is exemplified in a more specific set of words, each of which helps us to relate or order collections of things. All of the superlatives and comparatives are seriating words because they are relational (taller than, near, between, last, first, bigger than). By definition, all of the prepositions are also relational or ordering types of words.

As the teacher trains the child to classify and seriate, Piaget would view that same teacher as being involved in training the child to pre-reason. This is the tie between linguistic training in thinking.

BACKGROUND ON THE LRS-SERIATION TEST:

During the past three years an experimental project based in Iowa has been devoted to developing the LRS-Seriation Test (the ST), since ordering has been the neglected portion of the pre-reasoning field. This test was specifically designed to meet the needs of the culturally-different, lower-class child (who in the original test-development sample were also usually Afro-American). Using this population, the following has been determined:

1) The ST is a highly reliable instrument. A test-retest of 40 Afro-American kindergarten boys was conducted over a one-week span, as was a test-retest of 40 Caucasian kindergarten boys and girls. Additionally, reliabilities based upon factor analyses (communalities) were derived for over 100 four and five year old boys and girls, and for several hundred six and seven year olds. All of these yielded reliability estimates ranging from 0.91 to 0.95, which is better than the Binet can produce. This points to the extreme stability of the child's ability to pre-reason as well as to the reliability of the ST.

2) A concurrent validity estimate of 0.82 between the ST and the Metropolitan Readiness Test was obtained on a sample of several hundred deprived kindergarten youngsters. This would indicate that the ST is related to those kinds of achievement which are based upon mastery of two logical symbolic systems (reading and arithmetic).

3) Predictive data was obtained by administering the ST to several hundred kindergarten youngsters, and then giving an achievement test to these

same children after they were well into the second grade. In this instance predictive correlations of about 0.60 (ST versus reading and ST versus arithmetic) indicated that the ST is very useful for predicting a child's level of achievement over an extended period of time.

4) As would be expected, seriation is also highly related to intellectual functioning. The ST administered in the kindergarten versus the SRA-PMA given in the second grade yielded a correlation of 0.75.

PROBLEM:

In the preschool classes of the Stockton Unified School District several approaches are now being used in an attempt to locate more effective methods in the early education of culturally-different children. Three of these could be titled:

1) the traditional readiness and enrichment approach (TRAD, as at Van Buren and Taft).

2) the Bereiter-Englemann approach (BE, as at Garfield).

3) the Peabody Language Development Kit approach (PLDK, as at Nightingale).

The questions of interest are whether or not the SUSD preschool classes are effective in helping to develop children's pre-reasoning abilities and, if this is so, whether or not the various curricular approaches are of equivalent value. Accordingly, all of the children in each of three classrooms were individually given the ST in April and May of 1969. The following sets of questions and answers is designed to guide the reader's thinking through the maze of statistical analyses.

ANALYSES AND DISCUSSION:

Question #1: Are the SUSD preschool programs having a significant effect in terms of increasing the pre-reasoning abilities of the children enrolled?

Answer #1: There is little doubt but that the answer must be "yes." The ST has been analyzed by age levels, yielding three categories of abilities:

A: Experienced children who can discover, discuss, and elaborate.
B: Children intellectually and linguistically adequate for their age level, but who need actual objects in the learning situation.
C: Slower learners who are at the most basic level of learning (one-to-one matching in the number system, for example).

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C: Slower learners who are at the most basic level of learning (one-to-one matching in the number system, for example).

In relation to the ABC categories, the scores for the SUSD were tallied as follows:

Nelson
May 14, 1969

	S.U.S.D. TALLY BY AGE AND READINESS				
	4-0 4-5	4-6 4-11	5-0 5-5	Expected	Observed
A	2	11	3	15	16
B	7	12	8	30	27
C	3	7	7	15	17

Note that the SUSD tallies do not differ markedly from what would be expected. Therefore, one would conclude that the SUSD children are now as experienced in pre-reasoning as are large numbers of children who come from the full socio-economic spectrum but who have not had preschool experiences.

Question #2: Are there initial differences in intellectual functioning between the children at the time of entering the Van Buren, Nightingale, Garfield, and Taft preschools?

Answer #2: Probably not. A comparison of three groups showed that:
the BE average Columbia IQ was 97.17; the DAM average IQ was 83.86
the PLDK average Columbia IQ was 100.53; the DAM average IQ was 76.44
the TRAD average Columbia IQ was 97.75; the DAM average IQ was 78.00

Analyses of these scores showed that there was very little chance that these groups of scores actually differed one from another (Appendix A). In this case the TRAD group included Van Buren and a few children from the Taft School, since these children seemed to score at a similar level (Appendix B).

Question #3: If these children do start their preschool year experiences at about the same intellectual levels, then which approach seems to be producing the greatest pre-reasoning (or ST) growth?

Answer #3: The PLDK seems to produce greater pre-reasoning growth than either the BE or the TRAD approach, and the latter two approaches do not seem to differ significantly one from another (Appendices C and D). This is quite similar to these findings obtained when any initial intellectual differences as represented by the DAM IQs are subtracted out of the analysis (Appendix E). In other words, if Child K in the TRAD had been matched for IQ with another child in PLDK and BE, and if this were true of all children in these groups, the PLDK scores would still have been significantly higher.

Question #4: Is there any chance that the reported differences are due only to teacher capability?

Answer #4: Maybe not, although the evidence relative to this point is very shaky. Inclusion of a small group of scores from the Taft preschool classroom made no significant difference in the comparison of ST scores for Van Buren versus Garfield (Appendix F) as compared to the same analysis of Van Buren only versus Garfield (Appendix C). There was a small shift in average scores in a direction which would substantiate teacher differences, however, and this, coupled with the

fact that Nightingale was not included in this analysis, still leaves the teacher effectiveness question basically unanswered.

Question #5: Is there any chance that the pre-reasoning differences are due to or highly correlated with linguistic differences?

Answer #5: There is pretty good evidence in support of an answer of "no." Repeating the previous Van Buren - Garfield analysis (Appendix F) after having subtracted out the variable of language competency (as measured by Drennan's Title I Language Test) yielded almost identical statistical results (Appendix G). This would indicate that the estimate of experimental error was not changed significantly, and therefore that the ST scores and Title I scores were not at all highly correlated.

Although a sample of size 21 is obviously much to small to provide much of a stable correlation, the rank order correlation between the ST and the Title I test is actually only 0.05 (but keep in mind the instability of any correlation which is based upon such a small sample).

SUMMARY:

There seems to be little doubt but that the SUSD preschool classrooms which were researched in this report are having a significant effect upon their enrollees. The net result to the children involved is that their pre-reasoning abilities are now comparable to those representative of a broad socio-economic sample of children who are not involved in preschool programs. That is, the lower-class SUSD children should now be able to compete in pre-reasoning activities with middle and upper-class children.

There is also little doubt but that the three approaches seem to be having differing effects in producing pre-reasoning skills, with the PLDK seemingly being the better approach. It is most likely that this difference is due to the curriculum approach being used.

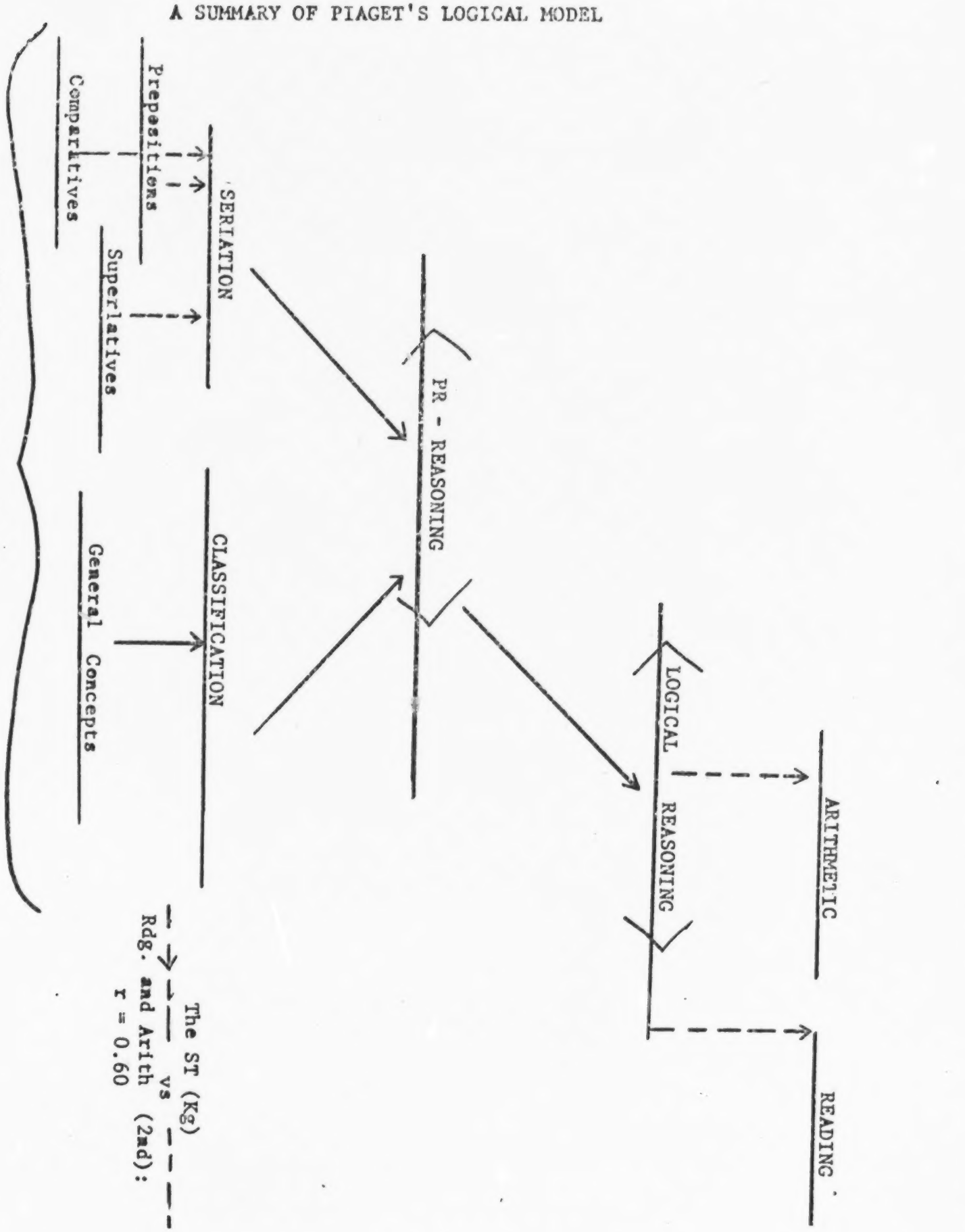
There is still a good likelihood that the teacher effect is operating so as to produce a part of the reported ST differences. This is natural since some teachers have had more experience with children and feel more at ease with the approach they are now using.

There is only a slight chance that a part of the differences is attributable to either initial intellectual differences or linguistic differences since both of these were fairly well controlled by the research design.

RECOMMENDATIONS:

1) Preschool enrollees' parents, SUSD professionals, and the general public should be made aware of the apparent effects of the preschool programs.

A SUMMARY OF PIAGET'S LOGICAL MODEL



THE FOLLOWING TABLE OMITTED DUE TO COST OF REPRODUCTION:

APPENDIX A: ANOVA OF COLUMBIA IQ, DAM FOR 5 SCHOOLS

B: MANN-WHITNEY U TEST

C: ANOVA, 3 SCHOOL

D: DUNCAN'S MULTIPLE RANGE TEST

E: ANOCOV

F. ANOVA

G. ANOCOV